Laboratory Information Systems and the Competency Trap

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Abstract

Hospital personnel are exploring ways to increase both production and clinical efficiency in the delivery of health care. Because laboratory information systems (LISs) will play such a critical role in this quest, these systems must perform optimally. The author discusses whether the persistence of older LISs and manual data processing systems within hospital clinical laboratories is related to the "competency trap." A competency trap occurs when continuing favorable performance with an inferior procedure leads an organization to accumulate more experience with it, thus avoiding experience with a superior procedure or keeping such experience at a low level.

Introduction: Production Versus Clinical Efficiency

The entire health care industry is currently in the throes of a series of wrenching changes prompted largely by the new reimbursement policies of third party payers and the subsequent need for a more cost-effective health care delivery system. Hospital personnel, including physicians, have come to understand that they must work more efficiently in this new and highly competitive environment.

What, then, are the means by which hospital managers and physicians can achieve greater efficiency and wring the waste out of the health care system without compromising the quality of care? Not surprisingly, hospital managers have first sought to implement changes in those areas where the cost of producing or purchasing goods and services can be reduced quickly and easily, thus enhancing the so-called *production efficiency* of hospitals.[1,2]

Examples of areas ripe for gains in production efficiency include the hospital clinical laboratories, pharmacy, and food service. In the case of the clinical laboratories, greater emphasis is being placed on automated specimen analysis. The cost of drugs for the pharmacy can also be reduced by group-purchasing arrangements negotiated by hospital consortiums and competitive bidding.

Another path for reducing costs within hospitals involves the effort to improve *clinical efficiency* which entails the modification of the selection, sequencing, and timing of good and services in order to minimize the cost of treating each individual patient. Clinical efficiency improvements have been much harder to achieve than those in production efficiency for obvious reasons: physicians exercise control over clinical decision-making and may be less malleable than hospital employees regarding proposed changes in their professional activities, particularly when they perceive that such changes may potentially degrade the quality of care they deliver. Nevertheless, hospital managers have no recourse now but to try to achieve greater clinical efficiency.

The ongoing development of automated information systems in hospitals will play a pivotal role in this shifting emphasis from production efficiency to clinical efficiency. One need only look at the ongoing evolution of laboratory information systems (LISs) to understand this change. Older LISs were designed primarily to enhance intralaboratory production efficiency. Such systems were thus batch-oriented, generated only hard-copy reports for clinicians, and were inflexible in terms of result reporting formats.

LISs can provide rapid on-line access to the laboratory data base The resulting decreased test result turnaround time for clinicians is an important component of the quest for increased clinical efficiency. The ability to select and sort results also provides an important *filter* for the test-ordering physicians.

Persistence of Older LISs and Manual Data Processing Systems

Given this background information concerning the increased emphasis on clinical efficiency, it is rather surprising that the clinical laboratories in many hospitals today, even larger ones with more than 500 beds, operate primarily with manual data processing techniques or, alternatively, with automated information systems that are relatively old. For example, it has been reported that only 25-30% of community acute care hospitals in the U.S. and Canada with over 100 beds had a complete automated laboratory information system in 1986.[3]

I believe that this persistence of manual data handling techniques or older LISs within hospital clinical laboratories can often be attributed to two factors: (1) the presence of the *competency trap* regarding information processing within clinical laboratories; and (2) the fact that the competency trap signal is often overlooked or ignored by laboratory personnel because hospital clinicians are not important participants in the decision-making process to buy or upgrade a LIS.

In order to discuss the competency trap in relation to data processing in hospital clinical laboratories and for the sake of completeness, I will first review the broad range of possible reasons for the persistence of manual handling processes or older LISs in such a setting. Following this, the competency trap will be discussed in detail.

The first possible reason is that clinical laboratory personnel, usually part of a not-for-profit enterprise, may not

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be subjected to the same competitive pressures for increased productivity as other organizations in the for-profit sector of the economy. Militating against this suggestion is the fact that there currently exists an intense competition between commercial clinical laboratories and hospital-based laboratories for market share of the testing business. This competition has resulted in vigorous price-cutting for both routine and esoteric tests, belying the notion that hospital-based laboratories are heavily insulated from the competitive marketplace.

A second possible reason is the belief on the part of some pathologists and hospital administrators that the installation or upgrade of a LIS may not actually enhance current laboratory productivity, and may, in fact, degrade performance because of the greater complexity of the new generation of LISs.

A third reason is that that the ability of laboratory personnel to correct even an acknowledged data-handling problem may be constrained by forces external to the management of the clinical laboratories. One possibility here is that there may be inadequate financial resources within the hospital to purchase or upgrade a LIS, or available resources are being directed by hospital administrators toward revenue centers rather than cost centers for strategic reasons.

A fourth external constraint on the actions of the clinical laboratory management is that a political stalemate may have developed within the hospital *vis-a-vis* the future development of laboratory computing, often a turf battle between the Pathology Department and the mainframe computer group concerning the location and control of the LIS. Friedman has previously discussed some of the difficulties encountered in planning hospital systems due to different goals and objectives between a departmental group such as the Pathology and the hospital mainframe group which reports to hospital administration.[4]

A fifth possibility is managerial timidity or lack of sophistication with regard to computerization of laboratory applications. A commonly encountered situation in this regard is that there may have been previous and unsuccessful attempts to install a LIS, moderating any enthusiasm for similar attempts in the future. At the very least, computers are generally viewed with some degree of trepidation within hospitals.

A sixth possibility, and the focus of this article, is that laboratory production and clinical efficiency is being constrained by the limitations of an existing manual processing system or older LIS and that this constraint is being overcome, at least in part, by organizational expertise and incremental resource expenditures. Such a scenario is called the competency trap.

I will now proceed to discuss in greater detail the manner in which the competency trap operates with regard to automated information systems within the clinical laboratories, placing particular emphasis on how and when it occurs.

Defining the Competency Trap

Levitt and March, in a discussion of organizational learning, emphasize that organizations learn to use routines, procedures, or strategies that lead to favorable outcomes for them.[5] The efficiency of an organization with regard to particular procedures increases with their continued use; successes with various procedures reflect both differences in the maximum performance potential of the procedure as well as the organization's degree of competence with them.

Although specialization is generally advantageous, a competency trap can occur when continuing favorable performance with an inferior procedure leads an organization to accumulate more experience with it, thus avoiding experience with a superior procedure or keeping such experience at such a low level that its future use becomes unrewarding. Competency traps are particularly apt to lead to maladaptive specialization when newer available procedures are far superior to the old ones. The *status quo* tends to be maintained until the differences in productivity potential between existing routines and new ones become substantial and obvious.

The Competency Trap in Relation to the Clinical Laboratories

Given the above definition for the competency trap, let us assume that there is at least some likelihood that the clinical laboratories within a hospital currently utilizing a manual information processing system or an older LIS may be enmeshed in it. In other words, a situation obtains whereby the pathologists and medical technologists within the laboratories have become increasingly comfortable with their current routines and procedures and have developed sufficient expertise to override any intrinsic disadvantages of them, thus fending off the implementation of a new system.

In my judgment, the competency trap may actually be much more likely to occur in relation to LISs within the clinical laboratories than in relation to, say, techniques and devices for the generation of test results. There is a much higher risk associated with the purchase and installation of a LIS than with the purchase of even an expensive and complicated automated laboratory instrument. For the most part, such devices perform as anticipated and have only a negligible failure rate.

This high risk associated with LISs has a chilling effect on the strategic planning of information systems and is related to:

- the large capital investment required to purchase and maintain automated information systems;
- the not inconsequential chance that such a system, having been purchased and installed, will fail totally or not meet expectations;

- the relatively arcane nature of computer systems which places high training demands on all users and makes normally self-assured professionals feel insecure.

Diagnosing the Competency Trap

Given the relatively high likelihood that the competency trap can occur in the clinical laboratories in relation to LISs, what then are the telltale signs and symptoms that such a problem exists? Knowing these signs and symptoms will allow the responsible laboratory personnel to recognize the existence of the competency trap and take appropriate action when it occurs.

Based on the previous discussion about the competency trap, it can be stated that the current manual or automated information processing system within the clinical laboratories will tend to be maintained until the productivity gap between the current and a new system becomes sufficiently large to justify risk-taking behavior and the implementation of a replacement system.

The basic issue with regard to the recognition of the competency trap reduces to the following question: what is the nature of the actual *signal* that such a productivity gap exists? *The signal is the gradual decline in the quality and efficiency of the information output of the clinical laboratories relative to competing organizations* (e.g., other local hospital laboratories and, to a lesser extent, commercial laboratories).

How Do LISs Add Value to the Data Processed?

To directly calibrate the usefulness of LISs on the basis of the quality and efficiency of data output seems to be too theoretical a concept and subject to misunderstanding and controversy. Following the lead of Taylor, I much prefer to discuss the contribution of LISs in terms of the extent to which they successfully add *value* to the data processed by them and, in so doing, increase in some manner the productivity of the various users of the output of the system. One can then examine the *value added* to data processed by the system to assess its enhancement of quality and efficiency.[6] In fact, Taylor's value-added model stipulates user criteria for assessing systems including ease of use, quality, time-saving, and cost-saving which are synonymous with quality and efficiency.

A key element to Taylor's approach to information systems is the user-driven model which is complementary to the content-driven and technology-driven models.[6] The user-driven model holds that the major input to the design of information systems must come from an analysis of the information use environments. We will now turn to a discussion of these different data environments in which laboratory information is used.

Different Data Processing Needs of Different Users

The idea that has been developed thus far is that the presence of the competency trap within the clinical laboratories is signaled by relatively poor performance in terms of the value added to data by the LIS or manual data handling system, such value being described and defined by the various individual system user groups. Such an approach to the understanding the competency trap then requires an analysis of the data processing needs of the various user groups in order to understand the system values they favor.

For the purposes of this discussion, I will suggest that there are three main user groups for the data output of a LIS: laboratory technical personnel including pathologists and medical technologists, clinical personnel including physicians and other health care professionals such as nurses, and administrators involved in both hospital and Departmental management.

How do these three user groups structure their work and the information necessary to buttress this work:

- *Laboratory technical personnel* place the greatest emphasis on production efficiency and the accuracy of data. They are analogous to assembly-line workers and are oriented toward batch processing and real-time operational control.[7] Long-term data archives are not considered critical for those working in "number" laboratories like chemistry and hematology.

- *Clinical personnel* focus on the care of individual patients. They view the generation of laboratory results as an intermediate step in the health care process. They demand accuracy and timeliness of test results and increasingly emphasize on-line access to data and long-term data archives.

- *Administrators* are oriented toward the management control rather than operational control capabilities of the LIS [7] and therefore emphasize retrospective batch reports. They tend to approach quality of care primarily from a *marketing of services* perspective.

The Missed Competency Trap Signal

Envision the clinical laboratories in a 400-bed hospital with automated data processing provided by seven-year-old LIS. The system is stable and operates efficiently with regard to the batch processing and high volume tests. Interfaces with the hospital mainframe computer and automated laboratory equipment are trouble-free. Bench technologists have electronic access to the data base via hard-wired terminals.

System response time is moderately slow but not so slow as to be extremely burdensome. Reporting of test results to clinicians occurs via hard-copy reports, telephone, and a small number of hard-wired terminals scattered throughout the hospital. One month's worth of data is available to clinicians on-line. The system is oriented toward the generation of individual inpatient laboratory reports and billing applications and produces only scanty information for retrospective management or quality control purposes.

I would submit here that the laboratories in this hospital are enmeshed in a competency trap and that the

signal that it is occurring is missed because the system is primarily meeting the needs, expectations, and values regarding production efficiency of only one of the three major system user groups--laboratory technical personnel. This is the group with the most significant decision-making capability for system replacement; without a champion for a new system within the clinical laboratories, personnel will commonly opt for maintenance of the *status quo*.

There may thus be few, if any, compelling reasons to replace an older LIS if no additional demands, either in terms of the ability to handle greater workload or enhanced system functionality, are placed upon it. An older automated system, or even a manual system, is commonly considered to be acceptable by laboratory personnel because they seek to *satisfice* rather than maximize or optimize system benefits [8] and they have different performance needs of the laboratory data base than other user groups.

Conclusion: Physicians as a Political Force Regarding Information Systems

Despite the problems enumerated above with regard to the persistence of manual data processing systems or older LISs, I foresee rapid changes in the very near future with regard to pressure for upgrades of existing LISs as hospital clinicians become politicized with regard to their participation in hospital data processing activities and make greater demands *vis-a-vis* the implementation of productivity tools in the clinical realm. Friedman and Dieterle have commented previously on this phenomenon.[9]

As physicians become more vocal and politically active regarding the development of medical information systems, there will be a greater impetus to upgrade existing obsolete laboratory data management systems and less of a tendency for laboratory technical personnel to fall prey to the competency trap. Physicians will demand sophisticated LIS and hospital communication features such as widespread electronic access to the laboratory data base, including terminals in their offices, and an on-line, one year archive of accessing test results. These demands will serve as the stimulus for LIS enhancements.

Laboratory managers and pathologists themselves will also become more vocal about LIS capabilities as hospital laboratories within a city or region become clustered and the need arises for more sophisticated telecommunications and billing options. This trend coincides with Korpman's suggestion that the pathologist is well-suited to assume the role of a medical information specialist in hospitals.[10]

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